

WHAT IS CLAIMED IS:

1. An illumination system for illuminating a surface by use of light from a light source, said illumination system comprising:

5 an emission angle conserving optical unit effective to emit the light from the light source at a constant divergent angle; and

a diffractive optical element for producing a desired light intensity distribution on a
10 predetermined plane;

wherein said diffractive optical element is disposed at or adjacent a position where light from said emission angle conserving optical unit is collected.

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2. An illumination system according to Claim 1, further comprising a multiple-beam producing element, and a light projecting element for superposing light beams from said multiple-beam producing element one
20 upon another on the surface to be illuminated, wherein the predetermined plane corresponds to a light entrance surface of said multiple-beam producing element.

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3. An illumination system according to Claim 2, further comprising a zoom optical system for projecting the light intensity distribution, produced

by said diffractive optical element, upon the light entrance surface of said multiple-beam producing element at a predetermined magnification.

5 4. An illumination system according to Claim 3, wherein there are a plurality of emission angle conserving optical units of different divergent angles, and wherein said emission angle conserving optical units are interchangeably set at a light path
10 in accordance with a change in magnification of said zoom optical system.

 5. An illumination system according to Claim 4, wherein an emission angle conserving optical unit
15 placed at the light path is changed by another, whereby a numerical aperture of light incident on the light entrance surface of said multiple-beam producing element is substantially registered with a preset numerical aperture of said multiple-beam producing
20 means.

 6. An illumination system according to Claim 1, wherein there are a plurality of diffractive optical elements for producing different light intensity
25 distributions on the predetermined plane, wherein said diffractive optical elements are interchangeably set at a light path to produce a desired light intensity

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distribution on the predetermined plane.

7. An illumination system according to Claim 1,
wherein said diffractive optical element is a phase
5 type or amplitude type computer hologram.

8. An illumination system according to Claim 1,
wherein said emission angle conserving optical unit
comprises a fly's eye lens having small lenses arrayed
10 tow-dimensionally.

9. An illumination system according to Claim 1,
wherein said emission angle conserving optical unit
comprises an aperture and a lens system.
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10. An exposure apparatus, comprising:
an illumination optical system for
illuminating a mask surface, as a surface to be
illuminated, with use of light from a light source,
20 said illumination optical system including (i) an
emission angle conserving optical unit effective to
emit the light from the light source at a constant
divergent angle, and (ii) a diffractive optical
element for producing a desired light intensity
25 distribution on a predetermined plane, wherein said
diffractive optical element is disposed at or adjacent
a position where light from said emission angle

conserving optical unit is collected; and

a projection optical system for projecting a
pattern formed on the mask surface, as illuminated
with the light from said illumination optical system,
5 onto a wafer.

11. A device manufacturing method, comprising the
steps of:

applying a photosensitive material to a
10 wafer;

illuminating a mask surface, as a surface to
be illuminated, with use of light from an illumination
optical system, wherein the illumination optical
system includes (i) an emission angle conserving
15 optical unit effective to emit the light from the
light source at a constant divergent angle, and (ii) a
diffractive optical element for producing a desired
light intensity distribution on a predetermined plane,
wherein the diffractive optical element is disposed at
20 or adjacent a position where light from the emission
angle conserving optical unit is collected;

projecting, through a projection optical
system, a pattern formed on the mask surface onto a
wafer; and

25 developing the transferred pattern.